What is claimed is:

1. System for limiting turbocharger rotational speed, comprising:

a turbocharger having a compressor defining a compressor outlet fluidly coupled to an intake manifold of an internal combustion engine and a compressor inlet, and having a turbine defining an exhaust gas inlet fluidly coupled to an exhaust manifold of the engine and an exhaust gas outlet;

a first pressure sensor producing a first pressure signal indicative of pressure at the compressor inlet;

a first temperature sensor producing a first temperature signal indicative of temperature at the compressor inlet;

means for determining an operating condition other than the pressure and the temperature at the compressor inlet, and producing a corresponding operating condition indicator;

a control mechanism for controlling a swallowing capacity or efficiency of the turbine; and

a control computer determining a maximum compressor outlet pressure value as a function of the first pressure signal, the first temperature signal, the operating condition indicator and a maximum turbocharger speed value, and controlling the control mechanism in a manner that limits compressor outlet pressure to the maximum compressor outlet pressure value to thereby limit rotational speed of the turbocharger to the maximum turbocharger speed value.

2. The system of claim 1 wherein the means for determining an operating condition is a means for determining an engine intake air flow rate corresponding to a flow rate of air entering the engine via the intake manifold;

and wherein the operating condition indicator is an engine intake air flow rate indicator.

3. The system of claim 2 further including:

an engine speed sensor producing an engine speed signal indicative of rotational speed of the engine;

a second pressure sensor producing a second pressure signal indicative of pressure at the outlet of the compressor; and

a second temperature sensor producing a second temperature signal indicative of temperature within the intake manifold;

and wherein the means for determining an engine intake air flow rate includes means for estimating the engine intake air flow rate indicator in the form of an engine intake air flow rate value as a function of the engine speed signal, the second pressure signal and the second temperature signal.

4. The system of claim 2 wherein the means for determining an engine intake air flow rate is a mass air flow sensor producing the engine intake air flow rate indicator in the form of an engine intake air flow rate signal corresponding to flow rate of air supplied from the compressor outlet to the intake manifold.

5. The system of claim 2 further including a memory having a three-dimensional map stored therein, the map having a first dimension in the form of a compressor pressure ratio defined by a ratio of the compressor outlet pressure and the pressure of air at the compressor inlet, a second dimension in the form of a corrected maximum turbocharger speed value computed as a function of the maximum turbocharger speed value and the first temperature signal, and a third dimension in the form of a corrected mass air flow computed as a function of the engine air inlet flow rate indicator, the first pressure signal and the first temperature signal;

and wherein the control computer is operable to determine the maximum compressor outlet pressure value by mapping current values of the corrected maximum turbocharger speed value and the corrected mass air flow to a current value of the compressor pressure ratio via the map and then multiplying the mapped value of the compressor pressure ratio by a current value of the first pressure signal.

6. The system of claim 1 wherein the means for determining an operating condition is an engine speed sensor producing an engine speed signal indicative of engine rotational speed;

and wherein the operating condition indicator is the engine speed signal.

7. The system of claim 6 further including a memory having a three-dimensional map stored therein, the map having a first dimension in the form of a compressor pressure ratio defined by a ratio of the compressor outlet pressure and the pressure of air at the compressor inlet, a second dimension in the form of a corrected maximum turbocharger speed value computed as a function of the maximum turbocharger speed value and the first temperature signal, and a third dimension in the form of engine speed;

and wherein the control computer is operable to determine the maximum compressor outlet pressure value by mapping current values of the corrected maximum turbocharger speed value and the engine speed signal to a current value of the compressor pressure ratio via the map and then multiplying the mapped value of the compressor pressure ratio by a current value of the first pressure signal.

8. The system of claim 1 wherein the control mechanism includes the turbine configured as a variable geometry turbine, the variable geometry turbine responsive to a control signal produced by the control computer to modify the swallowing capacity of the turbine.

9. The system of claim 1 wherein the control mechanism includes a wastegate fluidly coupled between the exhaust gas inlet and the exhaust gas outlet of the turbine, the wastegate responsive to a control signal produced by the control computer selectively modify the efficiency of the turbine by diverting exhaust gas therethrough and away from the exhaust gas inlet of the turbine.

10. The system of claim 1 wherein the control mechanism includes an exhaust throttle responsive to a control signal produced by the control computer to

selectively modify the efficiency of the turbine by controlling the flow rate of exhaust gas through the turbine.

11. The system of claim 1 further including a second pressure sensor producing a second pressure signal indicative of the compressor outlet pressure;

and wherein the control computer is configured to control the control mechanism in a manner that limits the compressor outlet pressure to the maximum compressor outlet pressure value by determining a pressure error corresponding to a difference between the maximum compressor outlet pressure and the second pressure signal, and by controlling the control mechanism in a manner that minimizes the pressure error.

12. A method of limiting turbocharger rotational speed, the method comprising:

determining an inlet pressure corresponding to pressure of air at an inlet defined by a compressor of the turbocharger;

determining an inlet temperature corresponding to temperature of air at the inlet of the compressor;

determining an operating condition other than the inlet pressure and inlet temperature;

determining a maximum compressor outlet pressure value, corresponding to a maximum allowable pressure at an outlet defined by the compressor, as a function of the inlet pressure, the inlet temperature, the operating condition and a maximum allowable turbocharger speed value; and

controlling a turbocharger swallowing capacity or efficiency control mechanism associated with a turbine defined by the turbocharger in a manner that limits compressor outlet pressure to the maximum compressor outlet pressure value to thereby limit rotational speed of the turbocharger to the maximum turbocharger speed value.

13. The method of claim 12 wherein the step of determining an operating condition includes determining a mass flow rate value corresponding to a mass flow rate of air supplied to the intake manifold by the turbocharger compressor.

14. The method of claim 13 wherein the step of determining a maximum compressor outlet pressure value includes:

determining a corrected maximum turbocharger speed as a function of the maximum turbocharger speed value and the inlet temperature;

determining a corrected mass flow rate as a function of the mass flow rate value, the inlet temperature and the inlet pressure;

mapping the corrected maximum turbocharger speed and the corrected mass flow rate to a compressor ratio corresponding to a ratio of compressor inlet and outlet pressures; and

determining the maximum compressor outlet pressure value as a product of the mapped compressor ratio and the inlet pressure.

15. The method of claim 12 wherein the step of determining an operating condition includes determining engine speed corresponding to rotational speed of the internal combustion engine.

16. The method of claim 15 wherein the step of determining a maximum compressor outlet pressure value includes:

determining a corrected maximum turbocharger speed as a function of the maximum turbocharger speed value and the inlet temperature;

mapping the corrected maximum turbocharger speed and the engine speed to a compressor ratio corresponding to a ratio of compressor inlet and outlet pressures; and

determining the maximum compressor outlet pressure value as a product of the mapped compressor ratio and the inlet pressure.

17. The method of claim 12 wherein the turbocharger turbine is configured as a variable geometry turbine;

and wherein the step of controlling a turbocharger swallowing capacity or efficiency control mechanism includes controlling the swallowing capacity of the turbine by controlling the geometry of the turbine in a manner that limits the intake manifold pressure to the maximum intake manifold pressure value.

18. The system of claim 17 wherein the step of controlling the swallowing capacity of the turbine includes:

determining the compressor outlet pressure;

determining a pressure error as a difference between the maximum intake manifold pressure and the compressor outlet pressure; and

controlling the geometry of the turbine in a manner that minimizes the pressure error.

19. The system of claim 12 wherein the turbine defines an inlet fluidly coupled to an exhaust manifold of the engine and an outlet, and wherein a wastegate is fluidly coupled between the turbine inlet and the turbine outlet, the wastegate controllable to selectively direct exhaust gas flowing out of the exhaust manifold through the wastegate and away from the turbine inlet;

and wherein the step of controlling a turbocharger swallowing capacity or efficiency control mechanism includes controlling the efficiency of the turbine by controlling the wastegate in a manner that limits the intake manifold pressure to the maximum intake manifold pressure value.

20. The system of claim 19 wherein the step of controlling the efficiency of the turbine includes:

determining the compressor outlet pressure;

determining a pressure error as a difference between the maximum intake manifold pressure and the compressor outlet pressure; and

controlling the wastegate in a manner that minimizes the pressure error.

21. The system of claim 12 wherein the turbine defines an inlet fluidly coupled to an exhaust manifold of the engine and an outlet, and wherein an exhaust throttle is configured to selectively control a flow rate of exhaust gas through the turbine;

and wherein the step of controlling a turbocharger swallowing capacity or efficiency control mechanism includes controlling the efficiency of the turbine by controlling the exhaust throttle in a manner that limits the intake manifold pressure to the maximum intake manifold pressure value.

22. The system of claim 21 wherein the step of controlling the efficiency of the turbine includes:

determining the compressor outlet pressure;

determining a pressure error as a difference between the maximum intake manifold pressure and the compressor outlet pressure; and

controlling the exhaust throttle in a manner that minimizes the pressure error.